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Periodic Pressure Oscillations at Malta

Pressure fluctuations are distinct features of the pressure records at Malta, particularly during early summer.* Changes so large and sudden which would be associated with line squalls in the British Isles, frequently occur at Malta with no violent surface phenomena. Definite periodic oscillations of pressure, however, are rare. Four cases only have occurred since records have been made during the last $11\frac{1}{2}$ years at Malta.

An example occurred in the early hours of June 6th, 1934. Periodic oscillations commenced at 1h. and ceased at 4h. The autographic records covering the period are shown in Fig. 1. The ten pressure peaks in this three-hour period coincide with ten maximum wind veers. The wind speed trace is defective but shows periodic oscillations, the minima coinciding with the maxima of pressure. Temperature and humidity vary slightly, but not in any periodic manner. The interesting fact is brought out, however, that these two quantities are inverse functions, revealing the constancy of absolute humidity and therefore show the homogeneity of the air mass at the surface. The periodic oscillations are due, therefore, to some upper air phenomenon.

Two synoptic charts nearest the time of the pressure oscillations are reproduced in Fig. 2. It will be seen from these that Malta, which was in a sector of warm air, lay to the south-east and almost on the

* *London, Meteor. Off., Prof. Notes,* No. 62.

boundary of a quasi-stationary front which produced large amounts of medium cloud but no rain except for a few drops (unmeasurable) on the 5th. The maximum temperature on the 6th was 14° below that of the 4th when the warm air first arrived at Malta from the Libyan desert. Levelling of temperature on each side of the cold front, owing to the breakdown of the pressure gradient and consequent stagnation, brought about its degeneration at the surface.

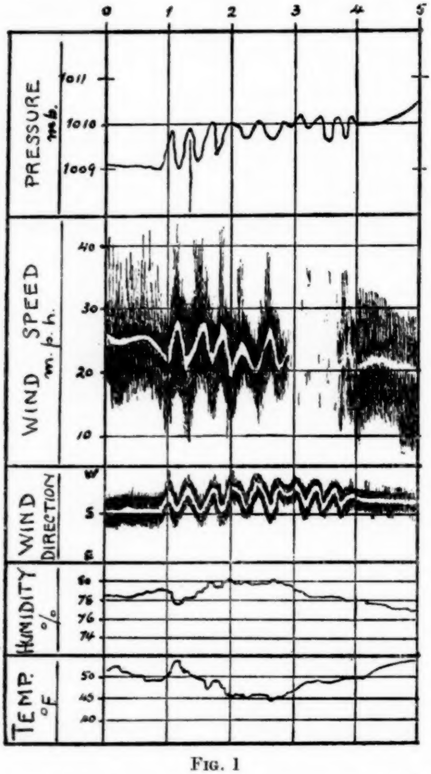


Fig. 1

Upper air temperatures of the 5th and 7th are represented by Fig. 3. These are applicable to the 6th since they are made in the same air mass. (Actually the cold front did not move eastwards on the surface after the 5th.) These graphs reveal convective equilibrium above the inversion level denoting air of true desert origin, having a potential temperature of over 100° F. The effect of cooling of the lower layer by contact with the sea is pronounced. Upper winds on both sides of the discontinuity were south-westerly and with the weakening of the surface pressure gradient the motion of the disturbances was along the front and not at right angles to it.

The pressure oscillations were undoubtedly caused by the intermittent encroachment of overrunning cold air. Any spasmodic bulging of cold air at right angles to its path would of course give spasmodic variations of pressure at the surface and would not explain the periodic oscillations. An explanation of the periodic oscillations is that the front itself in horizontal section was undulating and that a wave motion was taking place along the front. There is no indication

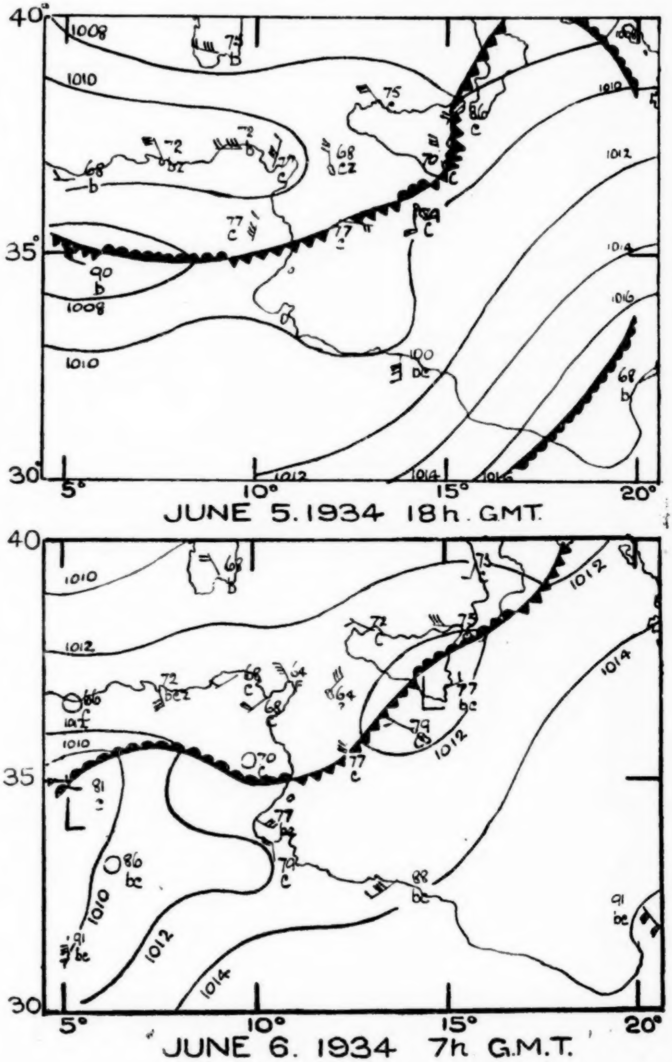
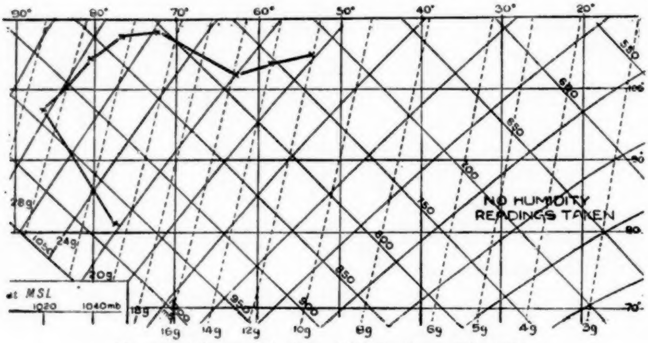
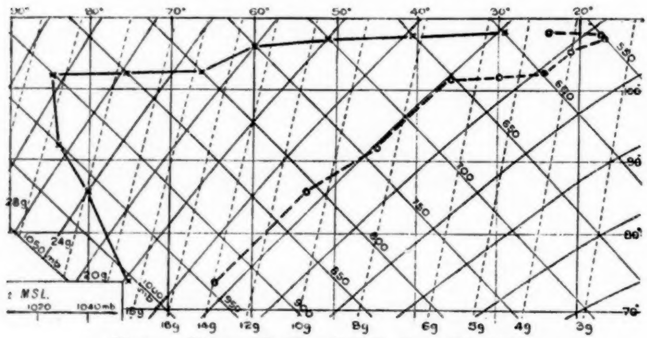

40°
35°
30°
5°
10°
15°
20°
1008
1010
1012
1014
1016
JUNE 5. 1934 18h. GMT.
40
35
30
5°
10°
15°
20°
1010
1012
1014
JUNE 6. 1934 7h G.M.T.

FIG. 2



HALFAR, MALTA, 8h. 45m. G.M.T., JUNE 5th, 1934.



HALFAR, MALTA, 6h. 35m. G.M.T., JUNE 7th, 1934.
FIG. 3. (See Note on p. 5.)

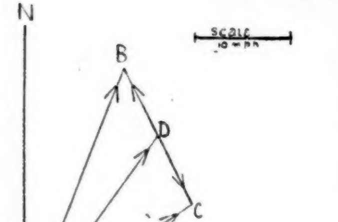


FIG. 4

of any bulging of cold air in the upper air temperature curves to account for periodic oscillations in pressure, but since the times of the ascents do not coincide with the time of the oscillations, no bulging would be expected. An analysis of the surface wind is made in Fig. 4. It can be seen that a wind vector varying periodically between NNW., 8 m.p.h. (DC) and SSE., 8 m.p.h. (DB) is added to the mean surface wind (OD).

As the oscillation originates from some upper air source a similar periodic vector change is taking place at some height above Malta. This is consistent with the hypothesis of the lateral oscillation of an upper front running approximately south-west and north-east. This front, which arrived at some height above Malta, remained for three hours, after which it withdrew and finally disappeared by complete degeneration.

A. WALTERS.

[NOTE.—In Fig. 3 the scale at the top represents air temperature, the lines sloping downwards from left to right pressure in millibars, and the vertical scale on the right, potential temperature.]

Problems of Meteorology

When as Editor of the *Quarterly Journal of the Royal Meteorological Society* Prof. D. Brunt in 1930 began the publication of a series of articles under the general title of "Some Problems of Modern Meteorology" he did one of the most useful things that could well be imagined. Sixteen articles appeared between 1930 and 1934 and the Society has now rounded off Prof. Brunt's distinguished services as Editor during that period by publishing the series in collected form at the modest price of three shillings and sixpence. To anyone who wants to know what meteorology has done and what it aims at doing, this clearly-written and authoritative symposium is indispensable.

The problems discussed in the series of sixteen articles cover a very wide range. Prof. Brunt himself contributes papers on the origin of cyclonic depressions, radiation and absorption in the atmosphere and the transformations of energy in the atmosphere. The last is perhaps rather more cursory than the importance of the subject would lead the reader to expect. Another article which strikes the present reviewer as erring on the side of brevity is that on seasonal weather forecasting by Dr. C. W. B. Normand. Mention is made of the use of world-wide charts of monthly, seasonal or annual anomalies as a possible basis for long-range forecasting, but Dr. Brooks' important paper on this subject in the *Quarterly Journal* for 1926 appears to have been completely overlooked.

Dr. Brooks contributes articles on the origin of anticyclones—a problem hardly less important than that of the origin of cyclones—and on post-glacial climates and the forests of Europe. In the latter paper the author has suffered from undue parsimony in regard to the scale of reproduction of the accompanying charts. As originally printed in the journal the charts were barely legible; as now reprinted they are illegible. It is only fair to state, however, that the "Replika" process employed for the production of this volume has, on the whole, yielded very good results.

In a volume devoted to the setting forth of problems one rather expects to find the question mark filling a prominent rôle. One

writer, Mr. M. G. Bennett, is to be commended for concluding his article on the condensation of water in the atmosphere by writing down a series of questions to which answers are required. The problems of Antarctic meteorology which await solution are also very clearly set out by Dr. Kidson. In some other articles the problems are not so clearly formulated, attention being devoted to what has been ascertained rather than to what remains to be ascertained. The research worker must, however, be fully informed of the existing state of knowledge before he can plan his attack on the unknown, just as an explorer needs an accurate map of the territory already surveyed by his predecessors before planning new expeditions. The "stocktaking" now put before us will undoubtedly save many hours of work for those who are able to devote their talents to the advance of meteorology. The paths to be explored are very alluring, even if they are beset with many pitfalls and quicksands. "Path" is perhaps an optimistic metaphor, since the progress of research is in some instances rather more likely to resemble the threading of a labyrinth or the blasting of a tunnel through a mountain.

One of the main objects of meteorology is the issue of weather forecasts, and it is not surprising that this aspect of the science should receive a large share of attention in the present publication. The view has recently been expressed that some new line of attack must be evolved before a major advance can be expected. To quote from Prof. Brunt's Introduction, "the time is surely ripe for some new idea to be brought forward, and many young meteorologists are eagerly looking for a new method which may help to elucidate some of the puzzling features of the physics of the atmosphere. But it is not clear where the new idea is to come from." Stimulated by these words the present reviewer feels impelled to put forward a suggestion, though with much diffidence. The observer who participates in the international exchange of weather information is required to make certain instrumental observations and to forward the data to headquarters. In his report he gives the temperature to the nearest degree Fahrenheit or Centigrade, the relative humidity rounded off to the nearest five per cent., the pressure measured to *one part in ten thousand*, and certain other things such as wind force, cloud amount, cloud height, etc., either estimated or measured very roughly. The point it is desired to emphasise is that one element, and one only, namely pressure, is measured and expressed with great precision. Now it is a fact that the first big step forward in forecasting was made when it was found that accurate readings of pressure, when reduced to sea level and plotted on a map, grouped themselves unmistakably into certain definite conformations which were related to the weather, and whose movements and developments could be followed from day to day. It is exceedingly doubtful if the isobaric systems would have been recognised and their importance realised had our predecessors

been satisfied to measure pressure with an accuracy of say five or ten per cent. It so happens that an accuracy of less than one part in a thousand is readily obtainable in the case of pressure. To attempt a similar degree of accuracy in the case of, say, wind velocity would be unprofitable because the wind velocity varies over a wide range from moment to moment. It seems possible, however, that a study of synoptic precision measurements of some such element as atmospheric moisture content might lead to important results. It is rather curious that although the importance of moisture in the atmosphere is increasingly emphasised by every fresh research the synoptic meteorologist appears to remain satisfied with very rough and ready determinations of its value. Would it not be worth while to inaugurate a campaign for the intensive study of this element in the hope that something would be added to our knowledge of the atmospheric processes which go to make up the weather ?

E. G. BILHAM.

A further discussion of the temperature at 4 Km. at Reykjavik and Duxford during the Polar Year

Nearly simultaneous observations were made at Reykjavik and Duxford on 210 days from September, 1932, to August, 1933. In the table below are given differences at 4 Km. for each season, also the number and percentage of occasions when the temperature at 4 Km. was higher at Reykjavik than at Duxford.

	No. of cases.	*Mean diff., °F.*	*No. of reversals*	*Per cent.*
Autumn (Sept.–Nov.) ...	57	18·2	3	5
Winter (Dec.–Feb.) ...	36	16·2	5	14
Spring (Mar.–May) ...	57	10·4	10	18
Summer (June–Aug.) ...	60	8·0	12	20
Year	210	{12·9 / 13·2}	30	14

The figure 12·9 is the mean of all cases, while 13·2 is the mean when each season is given equal weight. The percentage of reversals is 14, compared with 17 in my earlier article,* which was based only on the observations in the *Daily Weather Report.* These observations were received by wireless and only commenced at the end of October, and this explains the difference, since the percentage was lowest in the autumn.

The variability of the temperature at 4 Km. may be measured either by changes in 24 hours, or by standard deviations from the quarterly means. The results of both methods are given in the table below, the number of observations being given in brackets in each case. Only one observation per day was used, but all observations

* *Meteorological Magazine*, 68, 1933, p. 253.

on separate days were used, even when they were not simultaneous at the two stations. The number available for 24-hour changes is reduced by two when a single day is missed. The standard deviations are affected by long-period as well as short-period changes, and they are increased by seasonal changes, especially in spring and autumn. At Duxford in the summer of 1933 there was a period of low upper air temperature in June, and unusually high temperatures in July and August, and this raises the standard deviation for the summer.

	24-*hour changes*, °*F.*		*Standard deviations*, °*F.*	
	Reykjavik	*Duxford*	*Reykjavik*	*Duxford*
Autumn ...	6·0 (55)	5·5 (54)	10·0 (67)	9·4 (70)
Winter ...	6·1 (30)	7·1 (51)	9·2 (47)	9·5 (66)
Spring ...	4·5 (51)	5·2 (57)	10·2 (70)	7·3 (73)
Summer ...	4·0 (51)	3·6 (58)	6·3 (72)	7·5 (73)

Some additional figures for winter :—

Reykjavik, sea level pressure, mean 24-hour change 9·9 mb., standard deviation 24·2 mb.
Duxford, „ „ „ „ „ „ 6·5 mb., „ „ 10·9 mb.
Reykjavik, temperature at 1 Km., „ „ „ 5·6° F., „ „ 4·3° F.
Duxford, „ „ „ „ „ „ 5·1° F., „ „ 4·1° F.

The additional figures for winter are included because both the 24-hour changes and the standard deviation of temperature at 4 Km. are lower at Reykjavik than at Duxford at that season. This seems at first sight surprising, considering that the standard deviation of sea level pressure (taking only the cases when there were upper air observations) is much greater at Reykjavik. At 1 Km. the variability of temperature is greater at Reykjavik, but at 4 Km. this is reversed, which probably indicates that the latitudinal temperature gradient at 4 Km. is lower in Iceland than in England. This is no doubt due to the fact that the air to south of Iceland is predominantly maritime polar, in the genuine sense of that sometimes overworked term. The analyses of air masses on the published Bergen charts show no case from September, 1932 to April, 1933, inclusive, when there was tropical air at Reykjavik at 7h. There is little doubt that two small warm sectors consisting of tropical air crossed Iceland, but no upper air observation was made in them. According to J. Bjerknes,* the mean position of the Atlantic polar front in winter is from Cuba over Bermuda to the English Channel. This conception of the polar front differs from that given in the majority of text-books, and obviously represents the southern boundary of the initially very cold air which on the average flows south-eastward into the Atlantic between the Iceland "low" and the North American "high." The temperature difference between this maritime polar air and air of tropical or sub-tropical origin is very much larger at 4 Km. than near sea level, and this is probably the explanation of the result

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* *London, Q.J.R. Meteor. Soc.*, 58, 1932, p. 319.

brought out in the above table. A study of extreme cases supports this view. The temperature at 4 Km. in tropical air over Duxford was 24° F. on December 17th and February 4th, and 23° F. on February 9th, while the winter maximum at Reykjavik was 9° F. on December 7th and February 8th, not in tropical air, and 15° F. less than the Duxford maximum. The absolute minimum for the winter quarter was — 19° F. at Duxford on February 23rd, and — 26° F. at Reykjavik on January 18th, both cases being in arctic air, which penetrates to England fairly frequently, retaining most of its original coldness at the 4 Km. level. In a paper read recently at the Royal Meteorological Society, I showed that an air mass sometimes flows from Iceland to England with almost no temperature change at 4 Km., but on these occasions the temperature at 4 Km., though low, was not extremely low. In an extreme case the upward convection of heat in the cumulo-nimbus clouds developed over or near the sea would tend to be larger.

In summer, tropical air is less rare in Iceland than at other seasons. It should be remembered that the classification of air masses is sometimes quite arbitrary, being a matter of personal opinion, not always of a decided type. If the stability of the lowest kilometre is taken as a criterion, it is obvious that land and sea distribution exercises a very large influence, often producing stability over the sea in summer and instability in winter.

The "Iceland low" lies on the average position of the boundary between maritime polar and genuine polar or arctic air, often known as the "arctic front." No doubt this front is one of the main causes of the Iceland low itself, but some weight must be given to the fact that Iceland lies 2,000 miles north-east of the region to south of Newfoundland, where many depressions develop.* A depression starting with a large warm sector contains enough potential energy to deepen it during a passage of about 2,000 miles without any additional source of energy, provided that there is not too much frictional resistance. The open sea gives this condition, independently of its temperature. On the Atlantic to southward of Iceland there are frequently deep occluded depressions with a fairly uniform temperature round them. Depressions of essentially similar origin and nature often move to Iceland, and must contribute greatly to the low mean pressure. At the same time there is no doubt that the large temperature contrasts near Iceland play an important part in the development of new depressions and the regeneration of old ones. Depressions on the arctic front often resemble those on the polar front, but if the air in the warm sector is markedly unstable there are special features, as is sometimes shown in our own area. I summarised the question in a reply to the discussion of

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* The statistics given by Miss L. D. Sawyer (*London, Meteor. Off. Prof. Notes*, No. 50) for the development of depressions show a principal maximum off Nova Scotia and a secondary maximum near Iceland.

one of my papers.* Depressions in polar air are often slow and erratic in their movements, and their development tends to be rapid, though usually only for a comparatively brief period.

C. K. M. DOUGLAS.

OFFICIAL PUBLICATIONS

The following publications have recently been issued :—

GEOPHYSICAL MEMOIRS.

No. 63. *Wind records from the Bell Rock Lighthouse.* By A. H. R. Goldie, M.A., F.R.S.E. (M.O. (356*f*).

From time to time in the *Geophysical Memoirs* issued by the Meteorological Office there appear memoirs dealing with research on wind and wind structure. Notable examples in recent years have been *Geophysical Memoirs* No. 54, " The Structure of Wind over Level Country "—which was an exhaustive report on experiments carried out at the Royal Airship Works, Cardington, and *Geophysical Memoirs* No. 59, " A Survey of the Air Currents in the Bay of Gibraltar ". A further Memoir now issued, No. 63, " Wind Records from the Bell Rock Lighthouse ", is concerned with the behaviour of winds over the open sea. In 1929 an anemograph was erected on the Lighthouse ; the instrument is thus 12 miles distant from the nearest coast and it is also about 130 feet above water level. This Memoir gives some account of the wind structure as recorded at different times and seasons in this unique situation, and of the diurnal variations in wind speed and direction.

Averages of Bright Sunshine for the British Isles for Periods ending 1930 (*M.O.* 377)

This publication contains two main tables, the first of which gives average monthly totals, daily means and percentages of possible duration of sunshine for all stations having 10 years or more of observations in the period 1901–30. The second table gives for eighteen selected stations the average and percentage number of days in each month with sunshine within stated limits of duration.

The total number of stations for which averages are printed is 172 of which 31 are in Scotland and 9 in Ireland. For most stations the records cover a period of 20 years or more. The effect on the averages of variations in the number of years used is illustrated by tables in the Introduction.

The data show that the average annual duration of recorded sunshine varies from over 1800 hours in the Channel Isles and on the south coast of England to under 1100 hours in the Shetlands and in certain industrial areas where heavy smoke pollution occurs. At all stations May or June is the sunniest month, and December or January the dullest.

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* *London, Q.J.R. Meteor Soc.*, **55**, 1929, p. 151.

Discussions at the Meteorological Office

The subjects for discussion for the two meetings are :—

February 25th, 1935. (1) *Stratospheric steering during the cold period in February,* 1929. By R. Mügge; (2) *The change of stratospheric steering October* 1*st–8th,* 1932. By G. Stüve; and (3) *Stratospheric steering in the cold February of* 1932. *An example of an independent stratosphere system.* By H. Christians. (Frankfurt a. M., Synopt. Bearb. Nos. 1, 2 and 3. 1932–3.) (in German.) *Opener*—Mr. G. A. Bull, B.Sc.

March 11th, 1935. *Subsidence within the atmosphere.* By Jerome Namias (Cambridge, Mass., Harvard Meteor. Studies No. 2, 1934). *Opener*—Mr. E. G. Bilham, B.Sc.

Royal Meteorological Society

The Annual General Meeting of the Society was held on Wednesday, January 16th, in the Society's house, 49, Cromwell Road, S. Kensington, Lt.-Col. E. Gold, D.S.O., F.R.S., President, in the Chair.

The Report of the Council for the year 1934 was read and adopted and the Council for the ensuing year duly elected. Lt.-Col. Gold continues as President for a second year of office.

Lt.-Col. Gold delivered an address on " Fronts and Occlusions", of which the following is an abstract:—

The dividing surfaces between large masses of atmospheric air are called " frontal surfaces ". These masses of air are usually moving and consequently the frontal surfaces are also moving.

The line in which a frontal surface dividing different masses cuts the ground is called a " front".

A " warm front " is a front where the warm mass is replacing the cold mass at ground level. The front is therefore moving forward in the direction from warm air to cold air.

A " cold front " is a front where the cold mass is replacing the warm mass at ground level. The front is therefore moving in the direction from cold air to warm air.

There are also " stationary fronts " where warm air and cold air are both moving parallel to the front, so that the front itself does not move.

If a cold front and a warm front coalesce the result is an " occlusion " (or " shutting up " of the cyclone). The frontal surfaces in that case do not meet at ground level, but they do meet above the ground: and the warm air is above them, the cold air below them.

The weather phenomena associated with fronts have been known from the earliest times, but it was not until the nineteenth century that these phenomona began to be associated with the discontinuities known as fronts. Meteorologists then began to see the

connection between weather phenomena and cold fronts: but it was not until about fifteen years ago that the relation between weather phenomena and warm fronts was discovered, and that the role of fronts in the constitution of a cyclone began to be understood. In the last fifteen years a large number of investigations have been carried out to extend this work. They have dealt with the genesis of fronts and the dissolution of fronts: with the changes taking place in the air masses on the two sides of the frontal surface: and with the upward and downward motion of air at the frontal surfaces. Fronts and occlusions are now keystones in the science of weather forecasting and the increased accuracy of forecasts for short periods is largely due to a knowledge of these entities.

A number of examples of the genesis and dissolution of fronts (frontogenesis and frontolysis) are given, and the effect of vertical motion upwards or downwards in modifying the lapse rate or vertical fall of temperature is discussed. It is shown that if the descending motion is zero at the surface—as it usually would be—and becomes greater as the height above the ground increases, then the vertical fall of temperature in the atmosphere is replaced in a relatively short time by an isothermal state. Effects of this kind are usually found in the lower levels of the atmosphere—below about 1,500 feet.

Although the relation between fronts and weather and cyclones represents a great advance in meteorological knowledge, the question as to how the fronts originate has not yet been satisfactorily answered. The suggestion has been made that they are due to the difference of temperature between equator and pole. This is not an adequate explanation, because the transfer of energy from equator to pole could be effected without the large velocities required for, and associated with, fronts. It is suggested that fronts arise, primarily, owing to the discontinuities caused by the differences between radiation from continent and ocean, or from solid ice and open water, and that on a uniform globe the meteorologist's life would be free from both frontogenesis and frontolysis.

Correspondence

To the Editor, *Meteorological Magazine*

Green Ray at Sea

Miss C. M. Botley, of 17, Holmesdale Gardens, Hastings, has drawn attention to a letter by Mr. Stewart, of Swansea, which appeared in the *Radio Times* of November 2nd. In it he says that "while serving in the Persian Gulf and Indian Ocean on British Tanker Company's ships between 1926 and 1928 I saw it (the green ray) scores of times, probably because after seeing it once it became a temporary superstition to look for it on every possible occasion. . . . The point of interest is that one evening the Mate and I saw it twice. That evening there was a mirage effect on the sun, and two suns,

indistinguishable from one another set at a distance of roughly two suns apart. We saw the green ray from the first and then several minutes later again from the second when that set in its turn, both equally vivid." Miss Botley comments as follows " the interesting point is the duplication of the solar image apparently without distortion. It reminds one of Applegate's observation recorded in the *Meteorological Magazine*, 64, 1929, pp. 67–8."

A Flash of Lightning at Newport Pagnell, Bucks

I was driving a Morris Minor saloon car into Newport Pagnell, Bucks, at about 5.10 p.m. to-day, January 11th, from Northampton. The weather had been increasingly unpleasant as I left Northampton and after, strong wind and drizzling rain from the south-west—my " off " side.

As I was actually entering Newport and about 40 yards ahead of me I saw a violent explosion in the air about eight feet above the ground which reminded me forcibly of a small-calibre shell-burst. I felt nothing, but saw and heard the explosion which was accompanied by a bluish flame and was immediately immersed in torrential rain.

Inquiry later elicited the presence of heavy snow and hail falling at the time about 1 mile south. The subsequent thunder caused a good deal of local alarm, but I did not pause to inquire of any damage.

M. St. L. Simon.

4, *Stanmore Hall, Stanmore, Middlesex, January* 11*th*, 1935.

Sun Pillar seen from Linlithgow

This morning, around 9h., I observed that somewhat rare phenomenon—a sun pillar. At least 9/10 of the sky was unclouded at the time—a small amount of strato-cumulus being to the left of the sun pillar. The ground was snow-covered and frozen and the haze on the horizon gave the phenomenon a reddish-orange tint.

William G. Gray.

27, *Philip Avenue, Linlithgow. January* 8*th*, 1935.

The Christmas Storm

I have heard it said that the last week of the old year is sure to give a storm. While visiting Grayshott, on the Surrey border, recently I experienced what, according to the saying, would be the 1934 Christmas storm, and it occurred to me to investigate the matter in the records of the station there. " A storm " was assumed to be an occasion on which the wind force rose to " high," approximately Beaufort force 7, accompanied by appreciable precipitation. As the Beaufort scale of wind was not employed at Grayshott prior to 1912, the years studied were from 1912–34 (23 years). Of these,

only four, 1917, 1926, 1931, 1933 failed to give an occasion of "storm" during the last week of the year (December 25th to January 1st).

Gales and high winds at this time of year often spring up in the night hours, and the precipitation associated with them may occur on both sides of the succeeding morning observation hour. In some cases below the rainfall amounts for two days have been added when this has been the case.

TABLE I

(a) *Wind high, moderate rain*	(b) *Gale and heavy rain*	(c) *Gale and very heavy rain*
1912	1914	1915
1913	1922	1919
1916	1925	1924
1918	1927	
1920	1929	
1921	1934	
1923		
1928		
1930		
1932		
(10 years)	(6 years)	(3 years)

In Table I the years of storm have been grouped into (*a*) occasions of wind high and moderate rainfall (in no case has an occasion been counted as a storm if the associated rainfall has not exceeded 0·20 in.); (*b*) occasions of gale with heavy rain (rainfall associated with the gale, and measured between 9h. and 9h. between the limits 0·68 in. and 0·90 in.); (*c*) gale and very heavy rain (rainfall between 9h. and 9h. 0·90 in. or more).

The table is very simple owing to the fact that during the storms the strongest winds seem to have accompanied the heaviest rain.

Going back in the records further than 1912 the Christmas storm seems still evident, although the wind records are indefinite. For instance, in 1897 the observer wrote "one of the biggest storms of the year." The storm has usually been in a mild period, but on some occasions the precipitation has taken the solid form, particularly in 1906, 1908 and the memorable blizzard of 1927.

Perhaps the information given above merely reveals occurrences taking place according to the laws of probability; it has not been possible for me to calculate the probability of a "storm" occurring during the final week of the year, but the fact that only four years in twenty-three failed to provide a storm seems to indicate that, in the part of south-east England considered, the Christmas storm is a fairly regular occurrence.

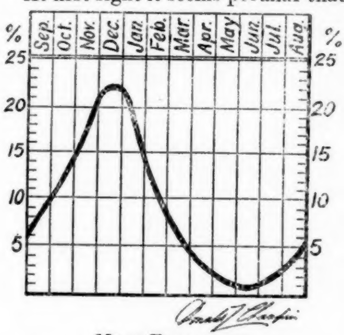
S. E. Ashmore.

19, Vicarage Road, Handsworth, Birmingham, 19, January 14th, 1935.

High Frequency of Calms in Winter

Based on observations of wind taken at Waltham Cross, Herts, during the ten years ending December 31st, 1934, there is a remarkably rhythmic distribution of calms throughout the year. In the attached diagram it will be seen that the percentage frequency of calms rises smoothly from a minimum of 0·8 per cent. in June to a maximum of 22·0 per cent. in December, the subsequent fall being as smooth as the rise.

At first sight it seems peculiar that the maximum frequency should occur during the winter quarter, but I have noticed that during this period the barometric gradient in England, south-east of the Chiltern Hills, is frequently influenced by continental anticyclonic systems, when the rest of the British Isles are suffering from high winds or gales associated with Icelandic depressions and this may account for the observed high frequency of calms.



MEAN FREQUENCY
winter 14·4 %, summer 3·4 %, annual 8·9 %

It would be interesting to know if the high frequency of calms in winter is experienced at other stations in south-east England, or if it is peculiar to the lower Lea Valley in which Waltham Cross is almost centrally situated.

DONALD L. CHAMPION.

7, Robinson Avenue, Goff's Oak, Waltham Cross, Herts., January 19th, 1935.

December, 1933, and December, 1934, at Guernsey

A remarkable occurrence in the weather of December, 1933 and December, 1934, at Guernsey is I think, worthy of notice.

December, 1933, was the coldest month of the name in forty years of observation at this station ; every day was colder than the normal and the month as a whole (mean 39·8° F.), 5·8° F. below the forty years' average, viz., 45·6° F. This long cold spell began on November 24th and ended on January 2nd, 1934. In rainfall the month's precipitation, 2·30 in., was 1·84 in. below the average, and the station recorded the first " absolute " December drought of the four decades, no rain being measured for 17 days, viz., from the 8th to the 24th.

On the other hand, and by a really extraordinary happening, as it seems to me, December, 1934, was the mildest December on record (41 years). Every one of its 31 days was warmer than the normal

and its mean temperature, 50·3° F., 4·7° in excess of the average. The month as a whole was 10·5° warmer than December, 1933. The mild spell began on December 1st and ended on January 5th. Another record has to be credited to December, 1934. It was the wettest December of 1894–1934 (41 years). Its total precipitation, 8·74 in., was 4·60 in. in excess of the average fall, which is 4·14 in.

One further remark with reference to December, 1933. Despite the fact of the month being very decidedly the coldest December in forty years of observation here, no really severe weather was experienced, and practically no frost. In proof of this, no temperature below 31·2° F. was recorded in the screen at Les Blanches, and the mean of the coldest day, the 12th, was as high as 34·3° F.—a low mean, certainly, for Guernsey in December but, taking the month's unprecedented depressed mean into consideration, nothing outstanding.

BASIL T. ROWSWELL.

Les Blanches, St. Martin's, Guernsey, January 30th, 1935.

The December Rains in southern England

The heavy rainfall of December, 1934, in the hilly counties south of the Thames was highly typical both as regards intensity and distribution of very wet winter months, and marked a feature of our climate which deserves comment. Apparently every county bordering on the Channel from Cornwall to Kent had between 5 and 10 inches of rain in December as a minimum, large tracts of country in the Downs of Sussex, Hampshire, Wiltshire and Dorset had between 10 and 20 inches, and small areas on the flanks of Dartmoor the colossal quantity of between 20 and 30 inches. To the lee of these southern ranges, on the contrary, London and Oxford had round about 5 inches, and Cambridge with numerous other East Anglian and Midland places only about 3 inches.

We may recall that this very wet area which barely had a single slight frost in December, 1934, lay for two or three weeks under snow in December, 1933—especially the south-western districts. Indeed the two Decembers had little in common but dark dank days.

L. C. W. BONACINA.

35, *Parliament Hill, London, N.W.3. January 22nd, 1935.*

Drizzle Falling from a Clear Sky

A remarkable case of drizzle falling without cloud occurred at Benson, Oxfordshire, on Sunday morning, January 20th, 1935. At 9.20 a.m. drizzle was observed, and as the sun was shining brightly the state of the sky was carefully studied. No cloud was visible although the blue of the sky was somewhat pale and watery, an effect which may well have been produced by the drizzle itself. The drizzle continued for ten minutes and during this period some cloud

formed though it was not overhead and did not appear to be the source of the drizzle. Some idea of the intensity of the precipitation can be formed by the fact that after its cessation a paving stone in the ground appeared moist and the sloping glass roof of a verandah was thickly covered with water particles. These, however, did not coalesce and run down the glass. The sun shining on the drizzle formed a rainbow though not of any particular brilliance. The cloud which began to form was probably of fracto-stratus type, though it was extremely difficult to form any idea as to its height above the ground. It continued to develop rapidly and three-quarters of an hour later the whole sky was heavily overcast and further drizzle occurred. As the first drizzle was unconnected with cloud it seems by no means improbable that this later drizzle may also have formed in clear air in the region between the cloud and the ground and the question naturally arises whether precipitation (rain or drizzle) may not be formed in clear air without passing through the initial form of cloud particles more frequently than is commonly supposed. It may be added that the conditions prevailing at Benson on the morning of January 20th were markedly anticyclonic. At ground level there was a calm though the clouds showed a light north-easterly wind above, the air temperature was 40° F. at the time and pressure approximately 1,040 millibars.

J. S. DINES.

January 21st, 1935.

Praktische Orkankunde

I thank you heartily for reviewing my book "Praktische Orkankunde," in the *Meteorological Magazine*. The reviewer errs in only one point.

> Crossley says (p. 245, November, 1934) :—" . . . . The author accepts Meldrum's statement that a large number of cyclones . . . . are stationary, but this view has not found much favour with recent writers . . . . In this connexion he quotes a statement by R. A. Watson, who gives the average life of a cyclone as 4½ days, but this appears to be a misunderstanding, for Watson's figure refers only to the existence of cyclones within certain limits, viz. . . . ."

The misunderstanding here is Crossley's, for he has apparently overlooked my sentence referring to Meldrum's stationary cyclones. Page 59 (translated) :—" The latter would be those whose progress is hindered by movements of anticyclones, as happens for example in West Indian hurricanes." In this sentence, I depart from Meldrum's statement and agree with recent writers. My reference to Watson concerns the small area of ocean which can be surveyed from Mauritius and which was mentioned a little earlier.

L. SCHUBART.

Rahlstadt, Friedrichstrasse 28, *December 2nd*, 1935.

Blue-green Moon in Calcutta

This, as reported in your September issue, strongly suggests association with those seen after the Krakatoa eruption in 1883. Writing from York on December 3rd, 1883 to *Nature* (December 6th, p. 131), I quoted from a letter of November 26th by my father, still a keen observer, although over 70 :—" A wide arc above the sunset was lit up with the most glorious pink shade. But the most remarkable of all was a longish cloud, to north of sunset and above and beyond the circle of pink, that was a bright sage-green. I never before saw such a colour in any cloud." The previous day I had recorded that from 2.45 to 3 p.m. " the clear sky from 10° to 25° or 30° from the sun (i.e., Bishop's Ring) was of a delicate rose pink. It gave a greenish-gray cast to cirro-cumuli through which it was seen."

Here we seem to have two distinct phenomena : after sunset a sage-green cloud beyond the rose-tinted sky, very lofty and not due to contrast and at a lower level an obvious contrast effect. The former, one associates with the " green moon " first recorded by me on December 3rd and 4th, 1883, from York and Street, as " blue-green " and at Eastbourne as blue, after a reference to green suns seen in September at Madras and further suggesting as cause Krakatoa impalpable dust at a great height.

In the possible absence of an eruption this year the green moon at Madras may perhaps be due to the recent abnormal dust storms. Symons' *Meteorological Magazine* of December, 1883, refers to a blue sun seen in Bermuda after the Barbadoes eruption of 1831.

J. EDMUND CLARK.

Street, Somerset. September 24th, 1934.

Weather Diary, 1808-1875

Mr. Richard Cooke, of The Croft, Detling, Maidstone, has kindly sent us extracts from and a summary of a weather diary kept by Henry Cox, the manuscript of which is at Wye College. The period covered by the diary is 1808 to 1875 and it is described as a " Journal of Natural Appearances and Occurrences in Farming, with occasional remarks on the weather, etc., made at Farningham, near Dartford, Kent, until Michaelmas, 1817 ; and since at Trevereux, near Limpsfield, Surrey." The extracts and summary have been deposited in the Library of the Meteorological Office.

Cloud formed by an Aeroplane

The cloud formation described below was produced by an aeroplane, and remained visible between 10h. 35m. and 11h. 10m. on November 8th, 1934. The cloud commenced to form from east to west at about 10h. 35m. in a thin, slightly curved horizontal band parallel to the

horizon, then rose vertically forming an angle of nearly 90°. This vertical band was narrow when formed but after a time it widened and became more diffuse. By 10h. 50m. it has fallen over to the left towards the horizontal band, which maintained its position unchanged all the time the phenomenon remained visible. By 11h. the cloud had fallen over sufficiently to come within a suitable position near the sun for a prismatic but ill-defined parhelion to form. From this fact it was obvious that the cloud consisted of ice crystals and was not exhaust-smoke from the aeroplane. After 11h. the cloud became more diffuse as already mentioned, and was then commencing to break up. The point at which the horizontal band joined the vertical one was apparently connected to a dense patch of cirro-cumulus which expanded and became broken into detached cloudlets, a faint line being traceable through it to the right from the point at which the two bands joined each other. The vertical band was densest at its edges, but the thinner horizontal one was uniform throughout; both were pure white, cirriform in appearance and at a considerable height.

The position of the cloud was west-south-west from the observation point, and at an altitude of about 45° from the horizon.

Soon after 11h. a mass of strato-cumulus advanced rapidly and at 11h. 25m. slight showers developed. Meteorological conditions on the ground at the time were quiet with a light (force 3) south-west wind following a west-north-west wind of force 1 early; frost occurred early in the morning but temperature after 7h. rose rather quickly. As the day advanced the wind increased considerably and after 16h. heavy rain set in; between this time and 18h. over half an inch fell, while from 18h. to 7h. on the 9th 1.54 in. occurred, the total for the 8th being 2·12 in. The 9th was very unsettled with a gale. The high clouds just described were travelling very slowly from west-north-west, while the strato-cumulus moved quickly from west-south-west.

The aeroplane which caused this cloud development was manœuvring at a great height. At 10h. 50m. two others passed almost overhead travelling towards the north-west, also at a considerable height and were difficult to locate although the atmosphere below the high cloud was clear; these two machines did not produce any trace of cloud development.

A. E. MOON.

39, Clive Avenue, Clive Vale, Hastings, November 15th, 1934.

NOTES AND QUERIES

Cumulus Cloud at Mount Batten

A very good example of cumulus cloud formation with a brilliantly white colouring is shown in the picture forming the frontispiece of

this volume of the magazine taken at Mount Batten by the local Photographic Section of the R.A.F. at about 10h. 15m. G.M.T. on August 4th, 1934.

The weather map for 7h. of the 4th showed a depression off the west coast of Scotland with a shallow trough extending from it to Cornwall moving north-eastwards. During the early morning the wind was light north-easterly. The clouds began to form with the arrival of a supply of maritime polar air when the temperature here rose 11 degrees in a few hours and the humidity dropped from 90 per cent. at 7h. to 69 per cent. at 13h. Slight showers were observed to fall from scud cloud before and after the formation of the line of cloud but at no time was rain seen to fall from the line of cloud itself.

The clouds of the picture were part of a complex system which formed in a dead straight line about four miles long and running from west-south-west to east-north-east. The whole system moved east-north-east along this line and maintained faithfully its general structure until lost to sight the only change noted being the gradual fading of the cumulo-nimbus part with a typical anvil cirrus at the extreme westerly end of the line. The whole base of the clouds remained very definitely marked showing calm conditions and it was interesting to see the cauliflower heads with Pileus veils above on the left of the picture though at the time the picture was taken the view was rather obscured by some of the many patches of scud cloud.

M. J. Thomas.

Aurora of December 29th, 1934

A display of the aurora seen in Scotland, Ireland and the south and west of England on the evening of December 29th, 1934, was described in the Daily Press and also by observers at some of the official stations of the Meteorological Office. Two independent descriptions from the neighbourhood of Oxford referred to an arch of light, the upper part of which faded for a time. Rays running up to the zenith were described by Lt. Col. A. Lloyd, Dryslwyn, Carmarthenshire, and rays like distant searchlight beams shooting out above the arched bank by Commander K. B. M. Churchill, Muston Manor, Dorchester. A more precise description by Mr. R. A. Hamilton, of 7, Worcester Crescent, Bristol, of the phenomenon as seen from Bristol, gave the positions of the regions of contact of the arc with the horizon as 29° and 69° west of north, the maximum elevation of the base as 4° and the width of the band as 3°. The star η Ursae Majoris (the "handle" of the "Plough") was seen to be shining through the band, which appeared pale green. Most of these observations were made between about 6.50 p.m. and 7.15 p.m.

At Aldergrove (Co. Antrim), the description was of a broad arc reaching an altitude of about 15° seen between 10 p.m. and

10.40 p.m., during which time it diminished in intensity. Accounts of luminous patches, resembling the high type of luminous night cloud studied in recent years by Prof. Carl Störmer, that were received from Worthy Down (near Winchester) and Aldergrove (Co. Antrim) presumably refer to the aurora, unless it can be supposed that two phenomena of such a different nature happened to appear simultaneously—an unlikely coincidence seeing that the luminous night clouds are rare, and the aurora very rare as far south as Winchester.

The Highest Recorded Wind Velocity

On Mount Washington in New Hampshire very high wind speeds are sometimes experienced. In order to obtain records of these high winds the Meteorological Observatory of Harvard University, which is situated on the summit 6,284 ft. above sea level, has been equipped with a new type of anemometer; this anemometer is rugged in construction to withstand the mechanical strain of the high winds and its cups (or fins) are electrically heated in order to prevent the accumulation of rime on the rotor. Last April a good record of a very high wind was obtained; a reproduction of the record and an account of the storm are given in the *Monthly Weather Review.**

The high wind occurred in association with an intense depression which was centred over the Great Lakes on the morning of April 10th and, moving south-eastward, was centred over Connecticut on the 12th. On Mount Washington pressure fell slowly from the afternoon of the 11th until 6 a.m. on the 12th, when it fell rapidly until the minimum of 22·82 in. (772·8 mb.) was reached at 12.45 p.m. By the morning of the 11th the wind, which was SE., had reached a velocity of 80 m.p.h., it increased steadily and during the following night the hourly movement was never less than 107 miles. On the morning of the 12th the wind speed increased rapidly and by noon it had reached 155 m.p.h. with gusts of over 200 m.p.h. The maximum speed occurred between 12 noon and 1 p.m.; during this hour the wind covered 173 miles. The highest gusts were timed by two observers with stop watches for the time taken for $\frac{1}{10}$ mile; S. Pagliuca gives the highest of these as 231 m.p.h. but C. F. Marvin† who discusses the calibration of the instrument gives the highest as probably 225 m.p.h. For a 5-minute period Marvin gives the greatest average velocity as about 200 m.p.h. The maximum 24-hour movement was from 4 p.m. on April 11th to 4 p.m. on April 12th with a total of 3,095 miles or an average of 129 m.p.h.

Pagliuca states that no serious difficulty was experienced by the

* The great wind of April 11–12, 1934, on Mt. Washington, N.H. and its measurement. Part I by S. Pagliuca. *Washington Mon. Weath. Rev.* 62, 1934, pp. 186–9.

† Ibid. Part III, by C. F. Marvin. pp. 191–5.

observers in attending to their necessary outdoor duties. He points out that at the height of Mount Washington the force of the wind is reduced by about $\frac{1}{5}$ of its value at sea level, and that on the rough rocky surface the velocity would be less than in the free air where the anemometer was exposed; but he also thinks that experienced men can adapt themselves to the impact of the wind. Only slight damage occurred, chiefly to the exposed instruments. The telephone line to the base station was undamaged. The building shook considerably but the covering of rough frost on the roof and on the exposed side increased the rigidity of the structure.

BOOKS RECEIVED

Records of the Far East Geophysical Institute, No. 11 (ix). U.S.S.R. Hydrometeorological Committee of the R.S.F.S.R., Vladivostok, 1932.

Weather types associated with Nor'westers in Bengal. By V. V. Sohoni. J. and Proc., Asiatic Soc. Bengal (New Series), Vol. xxviii, 1932, No. 1.

NEWS IN BRIEF

On his election as a member of the Chamber of Deputies, Commandant A. de F. Morna has retired temporarily from the Directorship of the Portugal Marine Meteorological Service for the period of this Parliament. Lieut. José de Castro e Sousa will take his place during this time.

Erratum

JANUARY, 1935, p. 295 *for* " 3·26 in., 2·36 in. and 2·33 in. at Fofanny (Co. Down) on the 4th, 14th and 25th, respectively " *read* " 2·33 in., 2·36 in. and 3·26 in. at Fofanny (Co. Down), on the 4th, 14th and 25th respectively."

The Weather of January, 1935

Pressure was above normal over western Asia except for the extreme north-west, over Europe except for the north-east, the south-east, southern Italy and Spitsbergen, over the North Atlantic as far south as latitude 35° and over North America except for some of the western States, the greatest excesses being 15·5 mb. at lat. 50° N., long. 30° W. and 5·6 mb. at lat. 60° N., long. 110° W., while the greatest deficits were 4·2 mb. at Brindisi and 4·1 mb. at Waigatz. In Sweden temperature and precipitation were above normal in Norrland but about or below normal elsewhere.

The outstanding features of the weather of the British Isles during January were the lack of rainfall, except in the eastern districts and the wintry conditions prevailing from the 26th–28th. In many places the rainfall was less than half the normal and Valentia reported the driest January since records began in 1866. Warm westerly winds prevailed during the first days of the month and temperature

was unusually high reaching 55° F. at many places, even in Scotland. Rain occurred generally on the 1st and mist or fog was experienced from the 1st to 3rd. After the 3rd temperature fell slowly as a depression moved south-eastwards from Iceland giving north-westerly winds over the country. Rain was generally slight during this period and some good sunshine amounts were recorded on the 4th and 6th, notably 7·2 hrs. at Plymouth and 6·6 hrs. at Blackpool on the 6th. Between the 7th and 9th sharp frosts were experienced, 15° F. on the ground at Auchincruive (Ayr) on the 8th and 16° F. at Rothamsted on the 9th, and snow or sleet fell in many parts of Scotland and eastern England. Mist or fog were recorded locally. With the approach of a depression from Iceland on the 9th, the weather became milder temporarily and rainfall was general on the 10th and 11th with heavy rain in the Isle of Wight. On the 11th S. gales veering W. were experienced in Scotland, Ireland and west England, Stornoway reported force 10 at 7h. and Pembroke force 10 at 13h. on the 11th. Thunderstorms occurred locally on the same day and snow fell in North Ireland and Scotland. The 12th was a sunny day in most parts with moderating north-westerly winds and local snow or sleet showers, 7·3 hrs. bright sunshine occurred at Calshot and Bournemouth. From then onwards an anticyclone gradually approached our south-west coasts, spread over southern England and moved northwards being centred over Scotland from the 18th to 20th, after which it withdrew south-west. After the 13th when snow was still being experienced in the north the winds backed and conditions became mild and rainy at first gradually changing later to colder and drier weather. Good sunshine records were obtained on parts of the south coast on the 15th and 18th, 7·6 hrs. at Weymouth on the 18th, but fog was experienced generally on several days. The approach of a depression from Iceland on the 22nd brought a gradual rise of temperature and many maxima above 50° F. were registered on the 23rd and 24th, 53° F. at Nairn on the 24th, and rain occurred generally on the 24th. From the 24th to 26th a deep depression moving from Iceland to Scandinavia caused strong W. winds and gales veering to N. on the 25th and 26th, force 9 was recorded at many exposed places in the north-east on the 25th, while gusts of 87 m.p.h. occurred at South Shields on the 25th and 26th and of 86 m.p.h. at Liverpool on the 25th. Temperature dropped considerably and snow fell in the north on the 25th and also in the south on the 26th (Hampstead had 4½ in.). Further snow fell in the eastern districts on the 27th and 28th, but temperature was rising in the west. Thunderstorms occurred locally in north England on the 25th–27th. On the 29th and 30th mainly cloudy conditions prevailed with local fog in the Midlands and eastern districts and drizzle in the west. On the 31st moderate rain fell in the extreme north but elsewhere the weather was bright and sunny with a moderate temperature, Leuchars had 7·7 hrs. bright sunshine. The distribution of bright sunshine for the month was as follows :—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs.)
Stornoway ...	23	− 4	Liverpool ...	48	− 4
Aberdeen ...	37	− 7	Ross-on-Wye ...	53	+ 1
Dublin	49	− 5	Falmouth ...	50	− 9
Birr Castle ...	33	−15	Gorleston ...	49	− 6
Valentia... ...	37	− 5	Kew	45	+ 1

Miscellaneous notes on weather abroad culled from various sources. Conditions for winter sports were good generally in Switzerland and Austria throughout the month. About the 8th the arctic regions of Russia experienced high temperatures for the time of year and after that date severe cold was felt from southern Russia to France and Italy; snow occurred on the Riviera on the 9th, but soon melted. Very heavy snow occurred in Yugo-slavia and Montenegro from about the 6th, parts of Serbia and Montenegro being quite cut off from the outer world. Snow and frost occurred in Naples on the 21st, and in Rome on the 22nd, while heavy falls of snow also occurred at Cagliari (Sardinia). Stormy weather accompanied by snow was experienced over north and west France on the 26th to 28th. On the 31st owing to heavy rain and snow the rivers Tunja and Maritza overflowed their banks in Thrace and washed away the railway near Adrianople. (*The Times,* January 5th–February 2nd).

A break occurred in the drought at Colombo about the 10th. Extreme cold was experienced in north-west and central India from about the 14th to 20th, temperatures below freezing-point being registered in the plains even at Delhi and Naushabro (Sind), while frost damaged the crops in various districts. The passes into Afghanistan were under snow. (*The Times,* January 11th–21st.)

Snow fell on the Tangier hills and there were also heavy falls of snow in the Grand Atlas near the end of the month. (*The Times,* February 1st.)

One of the worst storms ever experienced occurred near Darwin (Western Australia) about the 16th. Moderate to heavy rain fell in New South Wales about the middle of the month and in Queensland especially the Peninsula towards the end. (*The Times,* January 18th and *Rainfall in Australia, 3-day reports.*)

After a week of bitter cold there was an 18-inch snowfall in Vancouver on the 20th followed by incessant rain with strong winds until the 26th, 13 inches fell in 6 days. Floods were experienced generally in the coastal regions of British Columbia—all communications with Vancouver were cut off—while the interior and mountain districts suffered heavy snowstorms. Temperature was above normal during the first fortnight but later a cold spell began in the north-west States and from the 22nd onwards all Canada and the Middle and eastern United States suffered from intense cold and blizzards accompanied by severe gales in the eastern States on the 23rd–24th. Floods were reported

from several parts of the country especially in the north-west and the valley of the Mississippi. Many people were drowned or died from the cold. In the western States the temperature was high at the end of the month. Snow was experienced even as far south as Florida. Precipitation was below normal generally except for the third week. (*The Times*, January 24th–28th and *Washington D.C., U.S. Dept. Agric., Weekly Weather and Crop Bulletin.*)

Severe storms were experienced to the west of Iceland about the 25th and 26th. (*The Times*, January 26th.)

Daily Readings at Kew Observatory, January, 1935

Date	Pressure, M.S.L. 13h.	Wind, Dir., Force 13h.	Temp. Min.	Temp. Max.	Rel. Hum. 13h.	Rain.	Sun.	REMARKS. (see p. 1).
	mb.		°F	°F	%	in.	hrs.	
1	1020·2	WSW.2	47	53	91	0·08	0·0	r_0r 5h.–8h. & 8h.–10h.
2	1028·8	NW.2	51	54	87	0·06	0·0	frr_0 early.
3	1032·2	WNW.3	51	51	87	—	0·0	
4	1022·7	NW.4	45	48	66	—	6·0	
5	1019·1	NW.3	39	44	60	—	1·0	
6	1013·4	N.3	34	42	76	0·01	0·7	pr_0 9h., r_0 23h.–24h.
7	1017·6	N.3	34	38	85	0·01	1·4	r_0 3h., 15h. & 16h.
8	1024·4	NE.2	35	38	85	—	0·0	f 14h.–17h.
9	1029·8	CALM	27	35	92	—	0·0	Fx till 17h., f 18h.
10	1032·3	SSW.3	34	44	81	—	0·6	w late.
11	1020·4	SW.4	37	46	80	0·21	0·4	r_0 5h., 9h.; R 18h.
12	1011·0	NW.5	36	39	69	—	4·1	x late.
13	1014·2	W.1	32	41	82	0·08	1·4	r_0r 18h.–24h.
14	1018·1	NW.4	39	53	70	0·01	1·3	r_0 1h.–3h.
15	1032·6	W.2	43	51	82	—	4·5	w early; m. 21h.
16	1036·8	NW.2	43	48	78	—	0·0	F 19h.–24h.
17	1036·4	NNE.3	37	46	79	—	0·5	w early.
18	1037·9	ENE.4	42	45	69	trace	0·1	r_0 0h.–3h.
19	1037·9	NE.3	42	43	78	—	0·0	z 15h.
20	1039·2	NNE.2	39	43	80	—	0·9	z 13h.
21	1038·4	N.3	42	43	90	0·01	0·0	r_0 23h.–24h.
22	1036·2	NNE.3	39	48	71	trace	0·0	pr_0 6h.; f 21h.
23	1033·7	W.2	37	46	77	—	1·9	mw early.
24	1024·7	WSW.2	38	47	88	0·04	0·0	r_0 10h.–13h. & 15h.
25	992·3	W.4	44	50	81	0·24	0·5	s 21h.–22h.
26	999·9	NNW.5	34	42	54	0·08	0·2	rs 16h.–19h.; s 24h.
27	1018·4	NNW.4	32	38	68	0·03	5·0	s 0h.–2h.; rs 20h.
28	1026·5	N.3	29	38	64	—	6·7	x 7h.; f. 21h.
29	1026·1	NE.1	28	39	61	—	2·2	f till 13h.
30	1021·9	SW.2	33	42	90	—	0·6	f till 12h.
31	1021·7	NW.3	40	46	61	0·03	4·8	rr_0 0h.–4h.
*	1024·7		38	45	77	0·89	1·4	*Means or totals.

General Rainfall for January, 1935.

England and Wales ...	65	per cent. of the average 1881–1915.
Scotland	81	
Ireland	45	
British Isles	65	

Rainfall : January, 1935 : England and Wales

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
Lond .	Camden Square	1·09	59	*Leics* .	Thornton Reservoir ...	1·12	57
Sur .	Reigate, Wray Pk. Rd..	1·38	57	,, .	Belvoir Castle	1·60	90
Kent .	Tenterden, Ashenden...	...	...	*Rut* .	Ridlington	1·22	66
,, .	Folkestone, Boro. San.	2·33	...	*Lincs* .	Boston, Skirbeck	2·41	149
,, .	Eden'bdg., Falconhurst	1·16	47	,, .	Cranwell Aerodrome...	2·21	128
,, .	Sevenoaks, Speldhurst.	·88	...	,, .	Skegness, Marine Gdns.	2·13	123
Sus .	Compton, Compton Ho.	·97	30	,, .	Louth, Westgate	2·21	102
,, .	Patching Farm	·88	34	,, .	Brigg, Wrawby St	2·02	...
,, .	Eastbourne, Wil. Sq....	·88	33	*Notts* .	Worksop, Hodsock	1·68	95
,, .	Heathfield, Barklye....	·93	34	*Derby*.	Derby, L. M. & S. Rly.	·76	38
Hants.	Ventnor, Roy.Nat.Hos.	1·56	61	,, .	Buxton, Terr. Slopes...	3·84	86
,, .	Fordingbridge, Oaklnds	·76	28	*Ches* .	Runcorn, Weston Pt....	1·44	61
,, .	Ovington Rectory	·86	32	*Lancs*.	Manchester, Whit. Pk.	2·07	82
,, .	Sherborne St. John	·51	22	,, .	Stonyhurst College	3·21	75
Herts .	Welwyn Garden City ...	...	...	,, .	Southport, Bedford Pk.	1·80	71
Bucks.	Slough, Upton	·81	44	,, .	Lancaster, Greg Obsy.	1·76	50
,, .	H. Wycombe, Flackwell	·82	38	*Yorks*.	Wath-upon-Dearne	1·12	59
Oxf .	Oxford, Mag. College...	·59	34	,, .	Wakefield,Clarence Pk.	1·11	58
Nor .	Pitsford, Sedgebrook...	...	...	,, .	Oughtershaw Hall	2·67	...
,, .	Oundle	·57	...	,, .	Wetherby, Ribston H..	2·14	104
Beds .	Woburn, Exptl. Farm...	·77	45	,, .	Hull, Pearson Park	1·85	103
Cam .	Cambridge, Bot. Gdns.	2·23	149	,, .	Holme-on-Spalding	2·18	115
Essex.	Chelmsford, County Lab	1·69	110	,, .	West Witton, Ivy Ho.	1·55	49
,, .	Lexden Hill House	2·36	...	,, .	Felixkirk, Mt. St. John.	2·80	140
Suff .	Haughley House	2·28	...	,, .	York, Museum Gdns....	1·93	109
,, .	Campsea Ashe	2·49	137	,, .	Pickering, Hungate	3·28	157
,, .	Lowestoft Sec. School...	2·49	149	,, .	Scarborough	2·38	119
,, .	Bury St. Ed., WestleyH.	2·61	146	,, .	Middlesbrough	2·12	132
Norf. .	Wells, Holkham Hall...	1·99	137	,, .	Baldersdale, Hury Res.	...	...
Wilts .	Calne, Castleway	·68	30	*Durh* .	Ushaw College	2·58	126
,, .	Porton, W.D. Exp'l. Stn	·52	23	*Nor* .	Newcastle, Town Moor.	2·71	133
Dor .	Evershot, Melbury Ho.	·80	23	,, .	Bellingham, Highgreen	1·97	69
,, .	Weymouth, Westham.	·61	25	,, .	Lilburn Tower Gdns....	1·67	81
,, .	Shaftesbury,Abbey Ho.	·92	35	*Cumb*.	Carlisle, Scaleby Hall...	1·52	61
Devon.	Plymouth, The Hoe....	·71	21	,, .	Borrowdale, Seathwaite	13·00	103
,, .	Holne, Church Pk. Cott.	1·47	24	,, .	Borrowdale, Moraine...	4·26	42
,, .	Teignmouth, Den Gdns.	·50	17	,, .	Keswick, High Hill	3·17	63
,, .	Cullompton	·84	26	*West* .	Appleby, Castle Bank...	2·22	69
,, .	Sidmouth, U.D.C.	·47	...	*Mon* .	Abergavenny, Larchf'd	·91	27
,, .	Barnstaple, N. Dev.Ath	1·14	35	*Glam* .	Ystalyfera, Wern Ho.	2·18	34
,, .	Dartm'r,Cranmere Pool	3·10	...	,, .	Cardiff, Ely P. Stn	·89	24
,, .	Okehampton, Uplands.	1·43	28	,, .	Treherbert, Tynywaun.	2·53	...
Corn .	Redruth, Trewirgie	1·60	38	*Carm* .	Carmarthen, Priory St..	1·65	38
,, .	Penzance, Morrab Gdn.	1·89	50	*Pemb* .	Haverfordwest,Portfld.	1·49	...
,, .	St. Austell, Trevarna...	1·71	40	*Card* .	Aberystwyth	1·79	...
Soms .	Chewton Mendip	1·05	27	*Rad* .	BirmW.W.Tyrmynydd	3·15	50
,, .	Long Ashton	1·07	37	*Mont* .	Lake Vyrnwy	2·50	44
,, .	Street, Millfield	·66	27	*Flint* .	Sealand Aerodrome	1·44	73
Glos .	Blockley	·79	...	*Mer* .	Dolgelley, Bontddu	4·12	72
,, .	Cirencester, Gwynfa....	·78	31	*Carn* .	Llandudno	1·42	59
Here .	Ross, Birchlea	·77	32	,, .	Snowdon, L. Llydaw 9..	9·14	...
Salop.	Church Stretton	1·20	47	*Ang* .	Holyhead, Salt Island...	1·02	35
,, .	Shifnal, Hatton Grange	·99	51	,, .	Lligwy	2·44	...
Staffs.	Market Drayt'n, Old Sp.	1·06	48	*Isle of Man*			
Worc .	Ombersley, Holt Lock.	·84	44		Douglas, Boro' Cem....	2·16	64
War .	Alcester, Ragley Hall...	·98	51	*Guernsey*			
,, .	Birminghm, Edgbaston	1·06	53		St. PeterP't.Grange Rd.	1·00	34

Rainfall: January, 1935: Scotland and Ireland

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
Wig .	Pt. William, Monreith.	1·75	54	*Suth* .	Melvich....................	5·07	154
„ .	New Luce School.........	3·65	90	„ .	Loch More, Achfary....	12·53	172
Kirk .	Dalry, Glendarroch......	2·49	45	*Caith* .	Wick........................	3·57	145
„ .	Carsphairn, Shiel.........	4·55	62	*Ork* .	Deerness	4·86	141
Dumf.	Dumfries, Crichton, R.I.	1·41	47	*Shet* .	Lerwick	3·48	82
„ .	Eskdalemuir Obs........	3·22	60	*Cork* .	Caheragh Rectory.......	·90	...
Roxb .	Branxholm................	1·53	56	„ .	Dunmanway Rectory...	1·14	18
Selk .	Ettrick Manse............	2·44	52	„ .	Cork, University Coll...	·84	21
Peeb .	West Linton..............	2·64	...	„ .	Ballinacurra..............	·76	19
Berw .	Marchmont House......	1·81	80	„ .	Mallow, Longueville....	1·01	26
E.Lot.	North Berwick Res......	·85	49	*Kerry*.	Valentia Obsy............	1·07	19
Midl .	Edinburgh, Roy. Obs..	1·26	72	„ .	Gearhameen..............	3·60	35
Lan .	Auchtyfardle	1·83	...	„ .	Darrynane Abbey.......	1·45	29
Ayr .	Kilmarnock, Kay Pk....	2·71	...	*Wat* .	Waterford, Gortmore...	·63	17
„ .	Girvan, Pinmore..........	3·49	74	*Tip* .	Nenagh, Cas. Lough....	1·71	43
Renf .	Glasgow, Queen's Pk....	1·69	51	„ .	Roscrea, Timoney Park	1·58	...
„ .	Greenock, Prospect H..	3·25	48	„ .	Cashel, Ballinamona....	1·35	36
Bute .	Rothesay, Ardencraig...	3·50	...	*Lim* .	Foynes, Coolnanes......	1·57	41
„ .	Dougarie Lodge..........	2·50	...	„ .	Castleconnel Rec.........	1·46	...
Arg .	Ardgour House..........	10·52	...	*Clare* .	Inagh, Mount Callan....	3·02	...
„ .	Glen Etive...............			„ .	Broadford, Hurdlest'n.	1·35	...
„ .	Oban.......................	3·16	...	*Wexf* .	Gorey, Courtown Ho...	·80	26
„ .	Poltalloch..................	5·15	103	*Wick* .	Rathnew, Clonmannon.	1·24	...
„ .	Inveraray Castle.........	6·52	79	*Carl* .	Hacketstown Rectory...	1·39	39
„ .	Islay, Eallabus...........	3·50	75	*Leix* .	Blandsfort House.......	1·47	45
„ .	Mull, Benmore............	12·40	91	„ .	Mountmellick	1·57	...
„ .	Tiree	2·88	68	*Offaly*.	Birr Castle...............	1·24	44
Kinr .	Loch Leven Sluice.......	·72	23	*Dublin*	Dublin, FitzWm. Sq....	1·18	51
Perth .	Loch Dhu..................			„ .	Balbriggan, Ardgillan...	1·02	45
„ .	Balquhidder, Stronvar.		...	*Meath*.	Beauparc, St. Cloud....	1·65	...
„ .	Crieff, Strathearn Hyd.	1·13	28	„ .	Kells, Headfort..........	1·57	50
„ .	Blair Castle Gardens....	1·54	46	*W.M* .	Moate, Coolatore.........	1·45	...
Angus.	Kettins School...........	·93	35	„ .	Mullingar, Belvedere...	1·47	46
„ .	Pearsie House...........	·81	...	*Long* .	Castle Forbes Gdns......	1·57	47
„ .	Montrose, Sunnyside...	1·17	59	*Gal* .	Galway, Grammar Sch.	...	...
Aber .	Braemar, Bank..........	2·39	75	„ .	Ballynahinch Castle....	3·62	58
„ .	Logie Coldstone Sch....	1·96	89	„ .	Ahascragh, Clonbrock.	1·69	44
„ .	Aberdeen, King's Coll..	1·72	79	*Mayo*.	Blacksod Point..........	2·32	46
„ .	Fyvie Castle..............	2·36	100	„ .	Mallaranny	3·53	...
Moray	Gordon Castle...........	2·12	105	„ .	Westport House........	2·28	49
„ .	Grantown-on-Spey			„ .	Delphi Lodge.............	5·95	60
Nairn.	Nairn	1·23	62	*Sligo* .	Markree Obsy............	3·54	91
Inv's .	Ben Alder Lodge.........	3·83	...	*Cavan*.	Crossdoney, Kevit Cas..	1·34	...
„ .	Kingussie, The Birches.	2·57	...	*Ferm* .	Enniskillen, Portora....	1·62	...
„ .	Inverness, Culduthel R.	1·89	...	*Arm* .	Armagh Obsy............	1·44	57
„ .	Loch Quoich, Loan......	12·65	...	*Down*.	Fofanny Reservoir......	1·39	...
„ .	Glenquoich................	13·86	101	„ .	Seaforde	1·33	42
„ .	Arisaig, Faire-na-Sguir.	4·77	...	„ .	Donaghadee, C. Stn....	1·13	45
„ .	Fort William, Glasdrum	6·81	...	„ .	Banbridge, Milltown....	1·35	60
„ .	Skye, Dunvegan.........	5·78	...	*Antr* .	Belfast, Cavehill Rd.....	1·65	...
„ .	Barra, Skallary..........	4·37	...	„ .	Aldergrove Aerodrome.	1·20	44
R&C .	Alness, Ardross Castle.	2·11	56	„ .	Ballymena, Harryville.	2·13	57
„ .	Ullapool	4·33	94	*Lon* .	Garvagh, Moneydig....	2·24	...
„ .	Achnashellach	10·44	108	„ .	Londonderry, Creggan.	3·32	92
„ .	Stornoway	5·03	97	*Tyr* .	Omagh, Edenfel.........	2·40	68
Suth .	Lairg.......................	5·11	156	*Don* .	Malin Head...............	2·34	...
„ .	Tongue....................	3·63	92	„ .	Killybegs, Rockmount.	2·93	...

Climatological Table for the British Empire, August, 1934

STATIONS.	PRESSURE. Mean of Day M.S.L. mb.	PRESSURE. Diff. from Normal. mb.	TEMPERATURE. Absolute. Max. °F.	TEMPERATURE. Absolute. Min. °F.	TEMPERATURE. Mean Values. Max. °F.	TEMPERATURE. Mean Values. Min. °F.	TEMPERATURE. Mean Values. ½ Max. and Min. °F.	TEMPERATURE. Mean Values. Diff. from Normal. °F.	TEMPERATURE. Mean. Wet Bulb. °F.	Relative Humidity. %	Mean Cloud Am'nt 0–10	PRECIPITATION. Am'nt. in.	PRECIPITATION. Diff. from Normal. in.	PRECIPITATION. Days.	BRIGHT SUNSHINE. Hours per day.	BRIGHT SUNSHINE. Percentage of possible.
London, Kew Obsy....	1012·9	− 2·4	79	43	70·0	53·8	61·9	+ 0·3	55·1	85	7·0	1·77	− 0·47	12	6·2	43
Gibraltar..................	1015·3	− 1·2	91	63	83·5	66·6	75·1	− 0·9	64·3	79	2·3	0·00	− 0·12	0	...	...
Malta......................	1014·4	− 0·4	89	69	84·5	72·7	78·6	− 0·5	73·7	82	2·2	0·00	− 0·14	0	11·5	85
St. Helena	1016·4	+ 0·5	65	54	60·6	55·3	57·9	+ 0·5	56·0	95	9·5	3·89	...	19	...	...
Freetown, Sierra Leone	1014·3	+ 1·6	87	64	82·2	72·3	77·3	− 0·6	74·8	91	9·5	47·63	+ 11·06	25	...	...
Lagos, Nigeria	1013·7	+ 0·7	87	70	82·9	75·0	78·9	+ 1·0	74·8	88	9·2	7·91	+ 5·27	15	4·2	34
Kaduna, Nigeria	1009·8	...	87	65	81·9	67·4	74·7	+ 0·8	70·8	91	9·6	13·94	+ 1·62	25	2·7	22
Zomba, Nyasaland	1016·8	0·0	81	48	76·7	58·1	67·4	+ 2·5	61·3	67	4·7	0·00	− 0·37	0	...	...
Salisbury, Rhodesia...	1018·7	− 0·4	79	40	74·0	48·5	61·3	+ 1·1	52·7	51	1·8	0·01	− 0·05	1	8·5	74
Cape Town	1021·0	+ 0·7	74	39	62·4	48·0	55·2	− 0·4	49·3	89	5·8	3·35	− 0·02	13	...	...
Johannesburg	1019·8	+ 0·6	74	38	67·2	47·0	57·1	+ 2·7	45·6	48	2·0	0·82	+ 0·31	6	8·9	80
Mauritius	1022·5	+ 2·0	75	54	73·2	61·7	67·5	− 1·0	63·3	70	5·5	2·79	+ 0·44	22	7·8	68
Calcutta, Alipore Obsy.	1000·5	− 0·5	93	77	89·0	78·7	83·9	+ 0·7	79·8	91	7·8	14·10	+ 0·72	22*	...	...
Bombay	1005·3	− 0·6	86	74	84·0	76·2	80·1	− 0·7	76·7	89	9·1	14·07	− 0·38	25*	...	...
Madras	1005·7	+ 0·2	97	72	92·8	77·6	85·2	− 0·8	76·0	76	8·1	7·17	+ 2·63	8*	...	...
Colombo, Ceylon	1010·8	+ 1·5	86	73	84·9	77·0	80·9	− 0·3	77·2	80	7·0	1·46	− 1·78	15	6·8	55
Singapore	1010·0	+ 0·5	90	70	86·5	76·4	81·5	+ 0·4	77·3	81	7·8	5·95	− 2·00	14	5·8	48
Hongkong................	1007·2	+ 2·4	91	73	84·9	76·9	80·9	− 1·2	78·3	87	7·2	24·36	+ 9·96	18	5·9	46
Sandakan	1009·8	...	92	73	88·5	75·8	82·1	+ 0·3	76·9	82	6·9	6·91	− 0·98	16	...	...
Sydney, N.S.W...........	1016·6	− 1·6	73	41	63·2	48·3	55·7	+ 0·7	50·5	75	5·4	6·12	+ 3·15	16	5·8	54
Melbourne	1017·7	− 0·3	76	34	58·7	43·5	51·1	+ 0·1	46·9	77	6·4	1·97	+ 0·10	17	4·4	41
Adelaide	1018·6	− 0·7	73	40	62·0	46·5	54·3	+ 0·4	49·1	69	7·3	4·15	+ 1·62	19	4·7	44
Perth, W. Australia ...	1019·0	+ 0·1	76	40	65·5	48·5	57·0	+ 1·0	50·5	69	4·3	5·65	0·00	15	7·0	64
Coolgardie	1019·6	+ 0·3	74	37	65·2	44·9	55·1	+ 1·5	48·8	64	4·5	0·61	− 0·38	6	...	...
Brisbane..................	1018·6	− 0·6	77	41	70·1	51·0	60·5	+ 0·1	54·8	65	3·4	1·26	− 0·75	4	8·0	72
Hobart, Tasmania......	1014·4	+ 1·0	67	36	56·4	42·5	49·5	+ 1·5	44·5	70	5·9	1·30	− 0·53	14	4·9	47
Wellington, N.Z.	1019·1	+ 4·0	59	32	53·1	42·9	48·0	− 0·6	45·7	83	6·8	5·15	+ 0·66	20	4·1	39
Suva, Fiji	1015·6	+ 1·4	86	64	79·6	70·0	74·8	+ 1·2	70·5	79	7·3	5·23	− 3·06	18	4·7	41
Apia, Samoa	1012·3	0·0	87	66	84·6	73·0	78·8	+ 1·0	73·7	73	4·6	1·10	− 2·53	9	...	...
Kingston, Jamaica	1014·4	+ 0·9	93	70	88·8	73·1	80·9	− 0·6	72·7	80	3·4	4·98	+ 1·43	6	6·0	47
Grenada, W.I.	...	...	88	70	85	71	78	− 1·7	72·0	78	4	12·37	+ 3·04	23	...	...
Toronto..................	1016·3	+ 0·9	89	45	75·5	55·5	65·5	− 1·7	58·3	71	4·4	1·01	− 1·68	9	9·0	64
Winnipeg	1014·7	+ 1·5	92	34	73·7	51·0	62·3	− 1·5	51·4	83	5·5	3·28	+ 1·12	9	7·6	52
St. John, N.B.	1015·3	0·0	75	49	67·8	53·0	60·4	− 0·2	56·7	81	5·8	3·31	− 0·55	11	7·8	55
Victoria, B.C............	1017·6	+ 0·7	81	50	67·9	53·1	60·5	+ 0·8	56·0	78	3·8	0·65	+ 0·01	5	10·3	72

(24649) Wt. 25/32 1000 2/35 Hw. G.377/6

*For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen.